

# The genus *Aridelus* Marshall (Hymenoptera, Braconidae, Euphorinae) from Japan, with description of a new species

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## Abstract

Six Japanese species belonging to the genus *Aridelus* Marshall, 1898 (Hymenoptera, Braconidae) were recorded and photographed. Three species, *A. dubius* Belokobylskij, *A. egregius* Schmiedeknecht and *A. rufotestaceus* Tobias (= *Aridelus rufiventris* Luo & Chen **syn. nov.**), are new to Japan, and a new species, *A. rutilipoides* **sp. nov.** is described. An identification key to the Japanese species of *Aridelus* is also provided. In addition, new host records are provided, i.e., *A. flavicans* Chao reared from *Homoeocerus unipunctatus* and *Riptortus pedestris* (Alydidae) and *A. rufotestaceus* reared from *Glaucias subpunctatus* (Pentatomidae). The Alydidae is a newly recorded host family of *Aridelus*.

## Keywords

*Aridelus*, host records, identification key, new species, stink bug parasitoids, taxonomy

## Introduction

The braconid subfamily Euphorinae is unique in attacking a wide range of host orders, including both larvae and adult insects (Stigenberg et al. 2015). Its adult morphology varies greatly, probably due to adaptive evolution, which enables it to utilize a variety of free-living host insects (Shaw 1985, 1988; Maeto 2018).

The genus *Aridelus* Marshall, 1887 has an aberrant morphology, that is, the entirely areolate mesosoma and the elongated tubular first metasomal tergite. Using a petiolated metasoma with a short ovipositor, females lay eggs into nymphs or adults of heteropteran stink bugs (Shaw 1985; Maeto and Kudo 1992; Shaw et al. 2001). They are hitherto known to be solitary koinobiont endoparasitoids of the families Acanthosomatidae, Pentatomidae, Plataspidae, and Scutelleridae (Shaw et al. 2001). Although more than 40 species of *Aridelus* are known worldwide (Yu et al. 2016), only two species, *A. elasmuchae* Maeto & Kudo, 1992 and *A. flavicans* Chao, 1974, have been recorded in Japan (Maeto and Kudo 1992; Konishi and Maeto 2000).

In our study of Japanese Euphorinae, we identified six species of *Aridelus*, that is, *A. dubius* Belokobylskij, 1981, *A. egregius* (Schmiedeknecht, 1907), *A. elasmuchae*, *A. flavicans*, *A. rufotestaceus* Tobias, 1986, and *A. rutilipoides* sp. nov. In this study, all Japanese species are photographed, a new species is described, and an identification key to the Japanese species is provided. In addition, new host records of *A. flavicans* and *A. rufotestaceus* are presented herein.

## Materials and methods

The specimens examined were deposited in Kanagawa Prefectural Museum of Natural History, Odawara, Japan (**KPMNH**), Laboratory of Entomology, Faculty of Agriculture, Meijo University, Nagoya, Japan (**MUNJ**), Insect Museum, National Agriculture and Food Research Organization, Tsukuba, Japan (**NARO**), National Science Museum, Tokyo, Japan (**NSMT**), Osaka Museum of Natural History, Osaka, Japan (**OMNH**), Taiwan Agricultural Research Institute, Taichung, Taiwan (**TARI**), and Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia (**ZISP**). MsT. and LT. refer to a Malaise trap and a light trap, respectively. Besides six Japanese species, two females of *A. rutilipes* Papp, 1965 from Taiwan [2♀, Lixing Industry Road, Renai Township, Nantou County, 8.X.2015, So Shimizu leg. (TARI)] were also examined.

Morphological observation was conducted using a stereoscopic microscope (SMZ800N, Nikon, Tokyo, Japan). The specimens were photographed using a digital microscope (VHX-1000, Keyence, Osaka, Japan) with a 10–130× lens. Multi-focus photographs were stacked in the software associated with the Keyence System. The figures were edited using Microsoft PowerPoint 2019.

The morphological terminology used is mostly based on van Achterberg (1988, 1993). OOL, OD, and POL refer to the ocellar-ocular line, the diameter of the posterior ocellus, and the postocellar line, respectively.

## Taxonomic accounts

### Genus *Aridelus* Marshall, 1887

*Aridelus* Marshall, 1887: 66; Papp 1965: 181; Shenefelt 1969: 11; Shaw 1985: 309; Chou 1987: 21; Chen and van Achterberg 1997: 11; Belokobylskij 2000: 362. Synonyms are presented in Shenefelt (1969) and Shaw (1985).

**Type species (by monotypy).** *Aridelus bucephalus* Marshall, 1887.

**Diagnosis.** *Head* transverse; antenna filiform or moniliform, with 18 segments, its terminal segment with an apical spine; maxillary palp with 6 segments; labial palp with 4 segments; occipital carina complete or absent mediodorsally for a long distance, rarely completely absent, ventrally joining hypostomal carina; frons punctate or smooth with a median carina extending to frontal ocellus; face wider than clypeus in female; lower clypeal margin usually indented medially, rarely rounded; malar suture usually absent; mandibles overlapping each other; mesonotum, mesopleuron, and propodeum mostly areolate; petiolar notch extending nearly to mesocoxal insertions; parastigma large; vein 1-SR of fore wing absent to rarely shortly present and thickened; vein 3-SR of fore wing absent to distinctly present; vein 1-R1 of fore wing short; end of vein SR1 of fore wing much closer to pterostigma than to apex of wing; vein r-m of fore wing present; veins SR and 2-M of hind wing present, darkly pigmented; first metasomal tergite about 3/4 times as long as remainder of metasoma and completely fused ventrally; third tergite nearly reaching end of metasoma, following segments hidden; second and third tergites ventrally overlapping, without lateral fold; ovipositor and its sheath shortly exposed.

**Distribution.** Cosmopolitan and the most diverse in tropical regions (Yu et al. 2016).

**Bionomics.** Endoparasitoids of nymphs and adults of Acanthosomatidae, Pentatomidae, Plataspidae, and Scutelleridae (Shaw et al. 2001), and of Alydidae (present study). Usually diurnal, but a few species were collected at night in light traps (e.g., *A. dubius* in the present study).

### Key to the Japanese species of the genus *Aridelus* Marshall

- 1 Median carina of frons only weakly developed (Fig. 2B); occipital carina absent dorsally; inner margins of eyes not parallel, distinctly convergent ventrally (Fig. 2B); hind femur distinctly stout, 3.0× longer than wide (Fig. 2E); mesosoma black, head and metasoma except for first metasomal tergite black to dark brown (Fig. 2A); body length shorter, 2.7–3.7 mm [vein m-cu of fore wing postfurcal to interstitial (Fig. 2D)] ..... ***A. egregius* (Schmiedeknecht)**
- Median carina of frons distinct (Figs 1B, 3B, 4B, 7B); occipital carina complete; inner margins of eyes almost parallel or weakly convergent (Figs 1B, 3B, 4B, 7B); hind femur comparatively slender, at least 4.0× longer than wide (Figs 1G, 7H); body colour variable, but not entirely black (Figs 1A, 3A, 4A, 5A, 7A); body length longer, 3.6–6.5 mm ..... **2**

- 2 Head yellow, yellowish red, yellowish brown or reddish brown (Figs 3C, 4C, 5B, C); fore wing without distinct fuscous bands (Figs 3A, 4A, 5A) ..... **3**
- Head black (Figs 1C, 7C); fore wing with two distinct fuscous bands (Figs 1F, 7G)..... **5**
- 3 First metasomal tergite pale yellow, distinctly contrast to blackish or dark brownish second and following tergites (Fig. 3A); fore wing fuscous in distal half (Fig. 3A); mesosoma entirely black (Fig. 3A) [head yellowish brown; vein m-cu of fore wing postfurcal, rarely interstitial; body length 3.6–5.0 mm]....  
..... ***A. elasmuchae* Maeto & Kudo**
- First metasomal tergite yellowish red to reddish brown, not distinctly contrasting to second and following tergites (Figs 4F, 5A); fore wing hyaline or slightly infuscated medially (Fig. 4A, 5A); colour of mesosoma variable..... **4**
- 4 Vertex punctate and without transverse rugae (Fig. 4C); scutellum with median smooth area (Fig. 4E); mesosoma yellow to yellowish brown, not distinctly contrast to head and metasoma (Fig. 4A); penultimate segment of ♀ antenna 1.1–1.6× longer than wide (Fig. 4D) [vein m-cu of fore wing postfurcal to antefurcal; body length 4.1–5.3 mm] ..... ***A. flavicans* Chao**
- Vertex punctate, often transversely rugose (Fig. 5B, C); scutellum uniformly areolate, without median smooth area (cf. Fig. 7F); mesosoma reddish brown to black, usually distinctly contrasting to reddish head and metasoma (Figs 5D, E); penultimate segment of ♀ antenna 1.8–2.0× longer than wide [body length 4.5–5.7 mm]..... ***A. rufotestaceus* Tobias**
- 5 Penultimate segment of antenna 1.2–1.3 times as long as its width (Fig. 7E); antenna yellowish brown basally (Fig. 7D), darkened towards apex (Fig. 7E); face finely punctate laterally, transversely punctate-rugose medially; malar suture indistinct or absent; vein m-cu of fore wing distinctly antefurcal (Fig. 7G); apical hyaline area of fore wing comparatively large, almost reaching apex of marginal cell (Fig. 7G); hind femur slenderer, 4.6–5.2× longer than wide (Fig. 7H) [body length 5.8–6.5 mm]..... ***A. rutilipoides* sp. nov.**
- Penultimate segment of antenna 1.6–1.7× longer than wide (Fig. 1E); antennal segments entirely reddish brown (Fig. 1D, E); face fairly finely punctate; malar suture distinct; vein m-cu of fore wing slightly postfurcal to interstitial (Fig. 1F); apical hyaline area of fore wing comparatively small, not reaching apex of marginal cell (Fig. 1F); hind femur stouter, 4.1–4.3× longer than wide (Fig. 1G) [body length 5.1–6.1 mm] ..... ***A. dubius* Belokobylskij**

### ***Aridelus dubius* Belokobylskij, 1981**

Fig. 1A–G

*Aridelus dubius* Belokobylskij, 1981: 44. [Type locality: Russia]

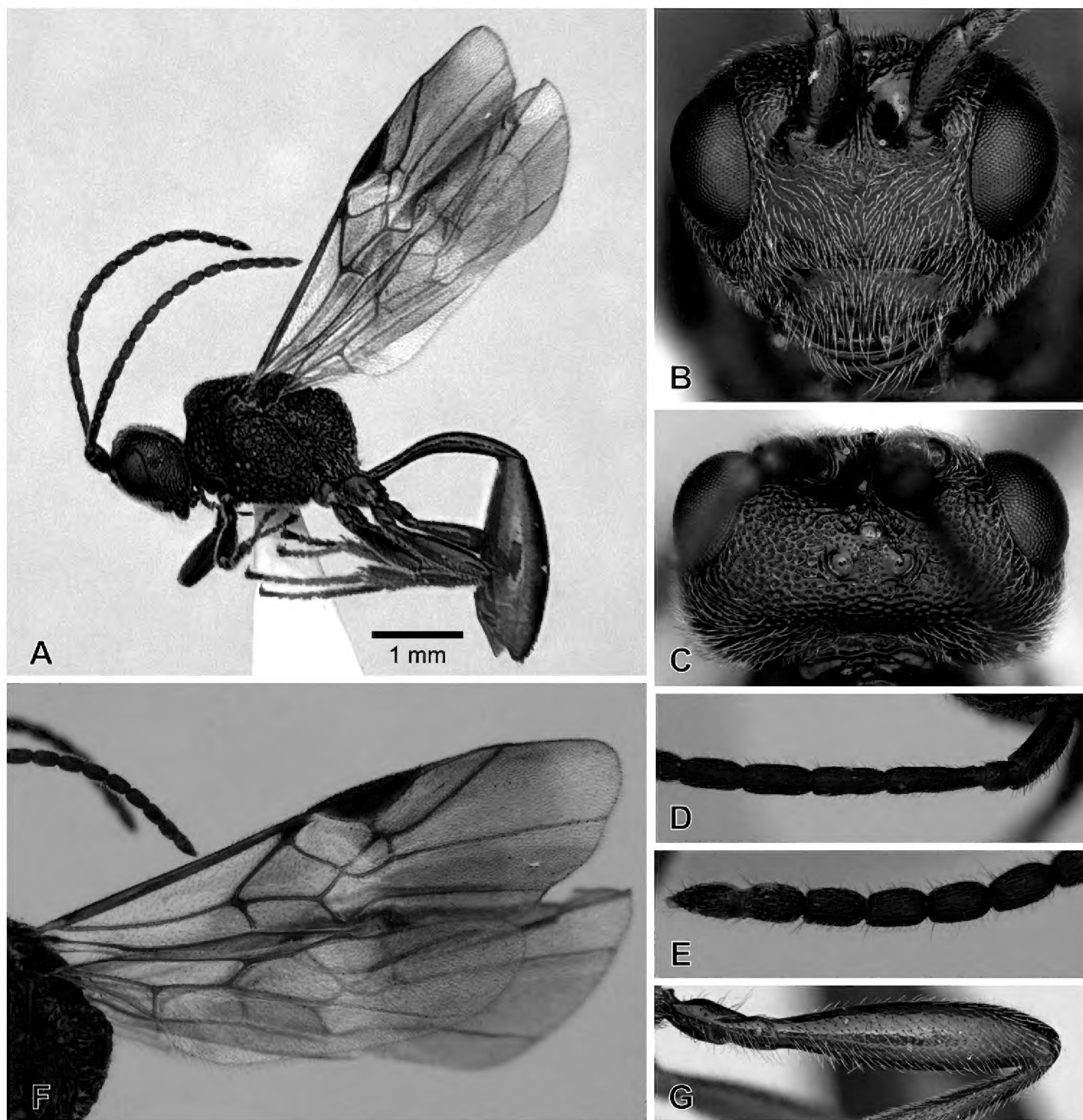
**Material.** JAPAN Honshû: 1♀, Niigata Pref., Myoukou City, Suginosawa, Sasagamine, 36-52N/138-4E, about 1200–1335 m alt., 18.IX.2013, S. Shimizu leg. (OMNH);



1♀, same data except 36-52-2N/138-4-42E, about 1300 m alt., 14.IX.2013, LT. (NARO); .1♀, Hiroshima Pref., Shôbara City, Saijô Town, Mts. Hiba, Tachieboshi Parking Lot, 30–31.VII.2019, LT., S. Shimizu leg (OMNH).

**Description. Females** ( $N = 3$ ) (Fig. 1). Body length 5.1–6.1 mm.

**Head** (Fig. 1B, C, D, E). Width of head  $2.0\text{--}2.2\times$  median length and  $1.0\times$  width of mesonotum. Length of eye  $1.1\text{--}1.3\times$  length of temple in dorsal view.  $\text{OOL} / \text{OD} = 4.0\text{--}4.1$ .  $\text{POL} / \text{OD} = 1.7$ . Vertex and temple densely punctate. Occipital carina complete. Frons smooth and shiny, with a distinct median carina. Face  $1.8\times$  as wide as high; finely punctate. Intertentorial distance / tentorio-ocular distance =  $0.4\text{--}0.5\times$ . Clypeus finely punctate, slightly concave medially, without apical teeth. Length of malar space  $0.4\text{--}0.5\times$  eye height. Malar suture distinct. Antenna filiform with 18 segments; 3<sup>rd</sup> segment  $3.8\text{--}4.0\times$  longer than wide and  $1.3\times$  longer than 4<sup>th</sup> one; penultimate one  $1.6\text{--}1.7\times$  longer than wide.



**Figure 1.** *Aridelus dubius* Belokobylskij, 1981, ♀ from Niigata Prefecture, Japan **A** habitus **B** head, frontal view **C** head, dorsal view **D** basal antennal segments **E** apical antennal segments **F** wings **G** hind femur.

**Mesosoma.** Mesosoma areolate, 1.3× as long as high. Scutellum without median smooth area.

**Wings** (Fig. 1F). Fore wing 4.4–4.7 mm in length, 1-R1 / length of pterostigma = 1.3–1.4, r / 3-SR = 2.3–3.5, m-cu slightly postfurcal. Hind wing with 1r-m / 2-SC+R = 0.7–0.9.

**Legs** (Fig. 1G). Hind leg: femur 4.1–4.3× longer than wide, length of femur: tibia: basitarsus = 1: 1.3: 0.6.

**Metasoma.** Metasoma smooth and polished. First metasomal tergite 6.0× longer than its apical width. Hypopygium truncated and excised apically. Ovipositor sheath hardly exerted beyond apex of metasoma.

**Colour.** Black. Palpi, antenna entirely, mandible, tegula, legs except for telotarsus and first metasomal tergite dark reddish brown; remainder of metasoma reddish brown, telotarsus and veins dark brown; pterostigma pale in basal 1/5 or faintly pale basally. Fore wing hyaline with two fuscous bands. Hind wing with a fuscous band in its apical third.

**Distribution.** Japan (Honshû: Niigata and Hiroshima Prefectures); Russian Far East (Belokobylskij 1981, 2000).

**Hosts.** Unknown.

**Remarks.** This species was described with only the male holotype available. The Japanese specimens mostly agree well with the original description (Belokobylskij 1981) and run in the key by Belokobylskij (2000) to *A. dubius*. The redescription of this species based on Japanese female specimens is represented here.

This species resembles *A. rutilipes* Papp described from Taiwan (Fig. 6) but differs in having the distinct malar suture (absent in *rutilipes*), the palpi dark reddish brown (light reddish brown in *rutilipes*), the apical hyaline area of the fore wing comparatively small, not reaching the apex of marginal cell (Fig. 1F) and the apico-posterior edge of the fore wing (in *rutilipes* comparatively large, almost reaching the apex of marginal cell and reaching the apico-posterior edge (Fig. 6A)), and the metasoma reddish brown to dark reddish brown (Fig. 1A) (dark brown in *rutilipes* (Fig. 6A)).

### *Aridelus egregius* (Schmiedeknecht, 1907)

Fig. 2A–E

*Helorimorpha egregia* Schmiedeknecht, 1907: 523. [Type locality: Germany]

*Aridelus egregia* (Schmiedeknecht): Muesebeck 1936: 6; Shenefelt 1969: 12.

*Aridelus nigricans* Chao, 1974: 455. Syn. by Belokobylskij 2000: 366. [Type locality: China]

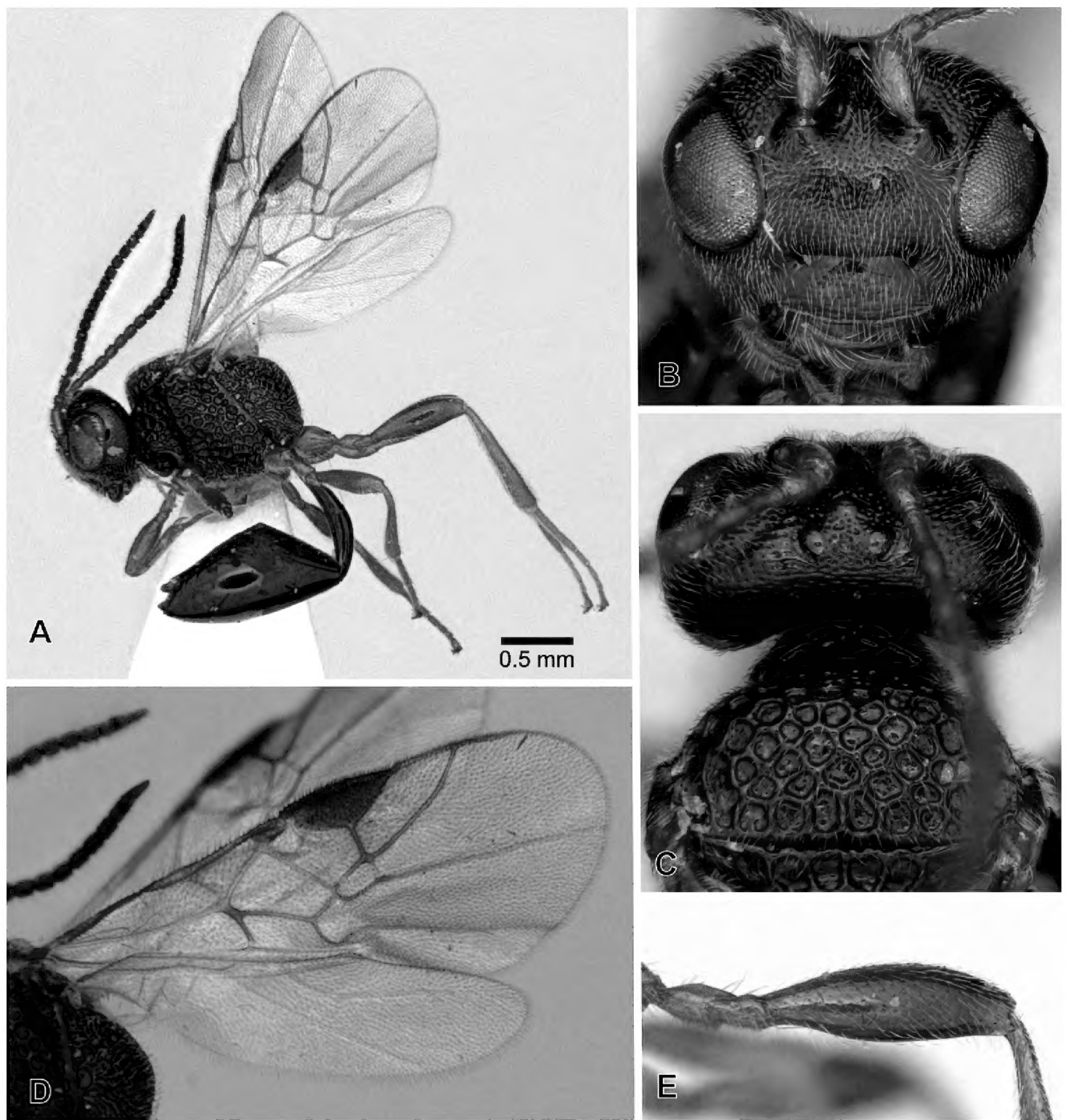
*Aridelus destitutus* Chou, 1987: 26. Syn. by Chen and van Achterberg 1997: 17. [Type locality: Taiwan]

**Material.** JAPAN Honshû: 1♀, Tôkyô Pref., Chiyoda Ward, Imperial Palace, Fukiagegyoen, Kajuen, 14–21.X.2009, MsT. (NSMT); 1♀, Fukui Pref., Tsuruga City, Marsh of

Nakaikemi, 19.IX–16.X. 2016, MsT., A. Noishiki leg. (OMNH). **Kyûshû:** 2♀♀, Ôita Pref., Mt. Sobo, 1600–1750 m alt., 27.IX.1979, K. Maetô leg. (NARO). **KOREA** 1♂, Kyongsangpuk-do, Mt. Sudo, 1000 m alt., 13–14.VII.1971, K. Yamagishi leg. (MUNJ). **TAIWAN** 2♂♂, Nantou Country, Renai Township, 2.V.2015, S. Fujie leg. (TARI).

**Distribution.** Japan (Honshû: Tôkyô and Fukui Prefectures; Kyûshû: Ôita Prefecture); Western Palaearctic region; China, Korea, Russian Far East, Taiwan (Yu et al. 2016; Lee et al. 2017). New to Japan.

**Hosts.** No host records are available in Japan, while Pentatomidae (*Aelia*, *Dolycoris*, *Eurydema*, *Holcostethus*, *Palomena*) (Dupuis 1952; Tobias 1986), Plataspidae (*Coptosoma*) (Capek and Davidova-Vilimova 1978), and Scutellaridae (*Eurygaster*) (Tobias 1986) are known host insects.



**Figure 2.** *Aridelus egregius* Schmiedeknecht, 1907, ♀ from Fukui Prefecture, Japan **A** habitus **B** head, frontal view **C** head and mesoscutum, dorsal view **D** wings **E** hind femur.



***Aridelus elasmuchae* Maeto & Kudo, 1992**

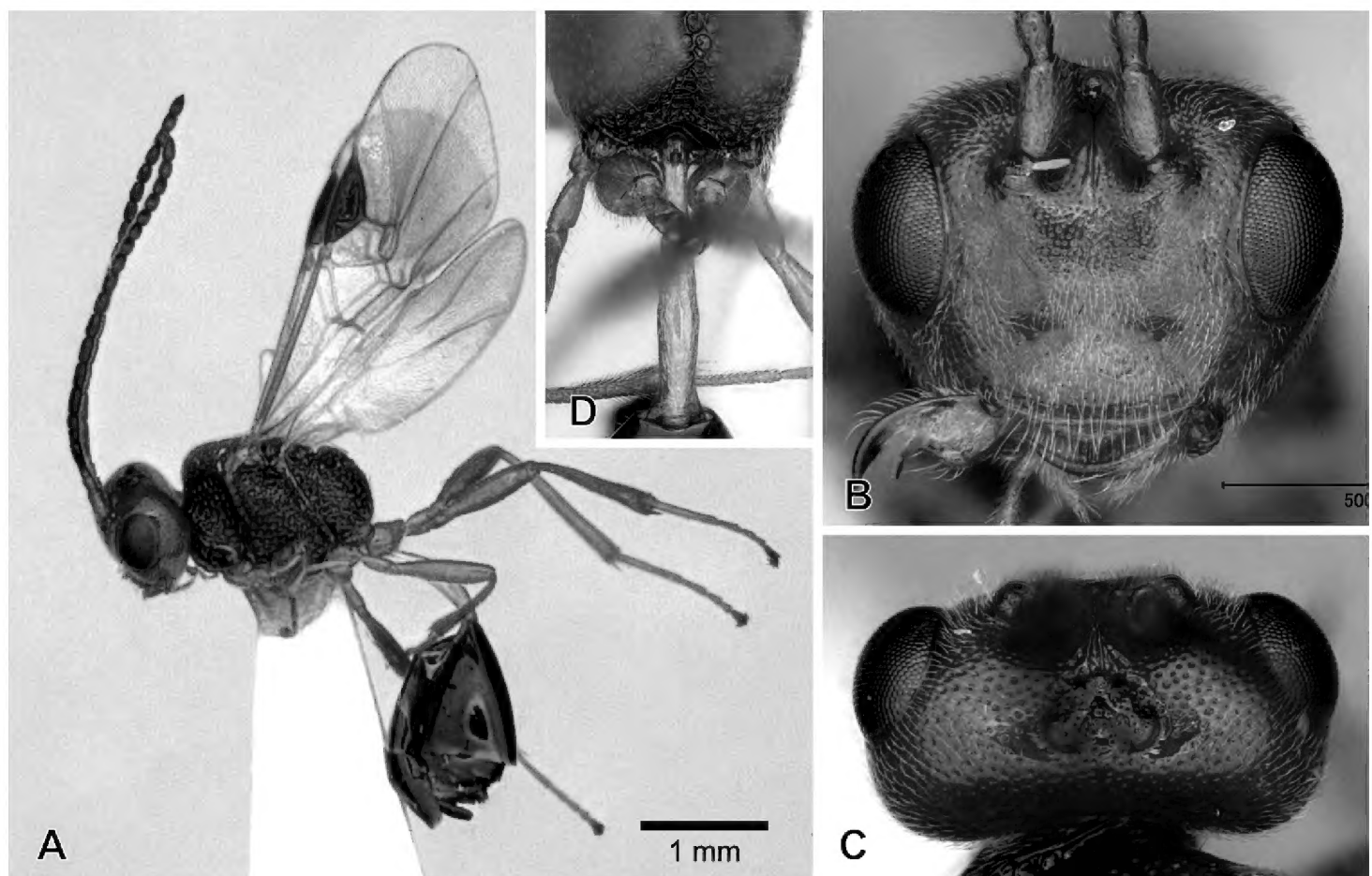
Fig. 2A–C

*Aridelus elasmuchae* Maeto & Kudo, 1992: 78. [Type locality: Japan]

**Material.** JAPAN **Hokkaidô:** 1♀, *holotype*, Nopporo, 15.VII.1986, S. Kudô leg. (NARO); 2♂♂, Sapporo City, Hitsujigaoka, 20–27.VI.2011, MsT., K. Konishi leg. (OMNH). 2♀♀ and 2♂♂, same data except 27.VI–4.VII.2011 (OMNH); 1♀, Kumaishi Town, Ken'ichi-gawa, Iwafuchi-zawa, 15–20.VI.1995, MsT., Y. Itô & T. Itô leg. (NARO). **Honshû:** 1♀, Aomori Pref., Mt. Iwaki, 28.IX.1983, M. Miyazaki leg. (NARO); 9♀♀ 7♂♂, Miyagi Pref., Minamisanriku Town, Hinokuchi, 5.VI–12.VII.2015, MsT., H. Yamazaki & S. Fujie leg. (OMNH); 2♂♂, same data except 28.IX–6.XI.2015 (OMNH); 1♀, Miyagi Pref., Minamisanriku Town, Mt. Tatsugane, 5.VIII.2016, S. Fujie leg. (OMNH); 1♂, Toyama Pref., Toyama City, Arimine, Jurodani, 1120 m alt., 7–14.VII.2009, MsT., M. Watanabe leg. (KPMNH); 1♀, Hyôgo Pref., Kami Town, Niiya, 20.VI–11.VII.2015, MsT., S. Fujie leg. (OMNH); 1♀, Hyôgo Pref., Kami Town, Niiya, 15.VI–14.VII.2013, MsT., S. Fujie & M. Itô leg. (OMNH). **Kyûshû:** 1♂, Kumamoto Pref., Izumi Vil., Mt. Hakuchô, 10.VII.1978, K. Ohara leg. (NARO).

**Distribution.** Japan (Hokkaidô; Honshû: Aomori, Miyagi, Tochigi, Toyama, Hyôgo and Tottori Prefectures; Shikoku: Ehime Prefecture; Kyûshû: Ôita Prefecture) (Maeto and Kudo 1992; Takahashi and Shiraishi 2018; Fujie and Katayama 2020; present study); Russian Far East (Yu et al. 2016).

**Hosts.** *Elasmucha putoni* Scott, 1874 (Acanthosomatidae) (Maeto and Kudo 1992).



**Figure 3.** *Aridelus elasmuchae* Maeto & Kudo, 1992, ♀ from Hyôgo Prefecture, Japan **A** habitus **B** head, frontal view **C** head, dorsal view **D** first metasomal tergite, dorsal view.



***Aridelus flavicans* Chao, 1974**

Fig. 4A–F

*Aridelus flavicans* Chao, 1974: 455; Chou 1987: 23; Luo and Chen 1994: 484; Chen and van Achterberg 1997: 16. [Type locality: China]

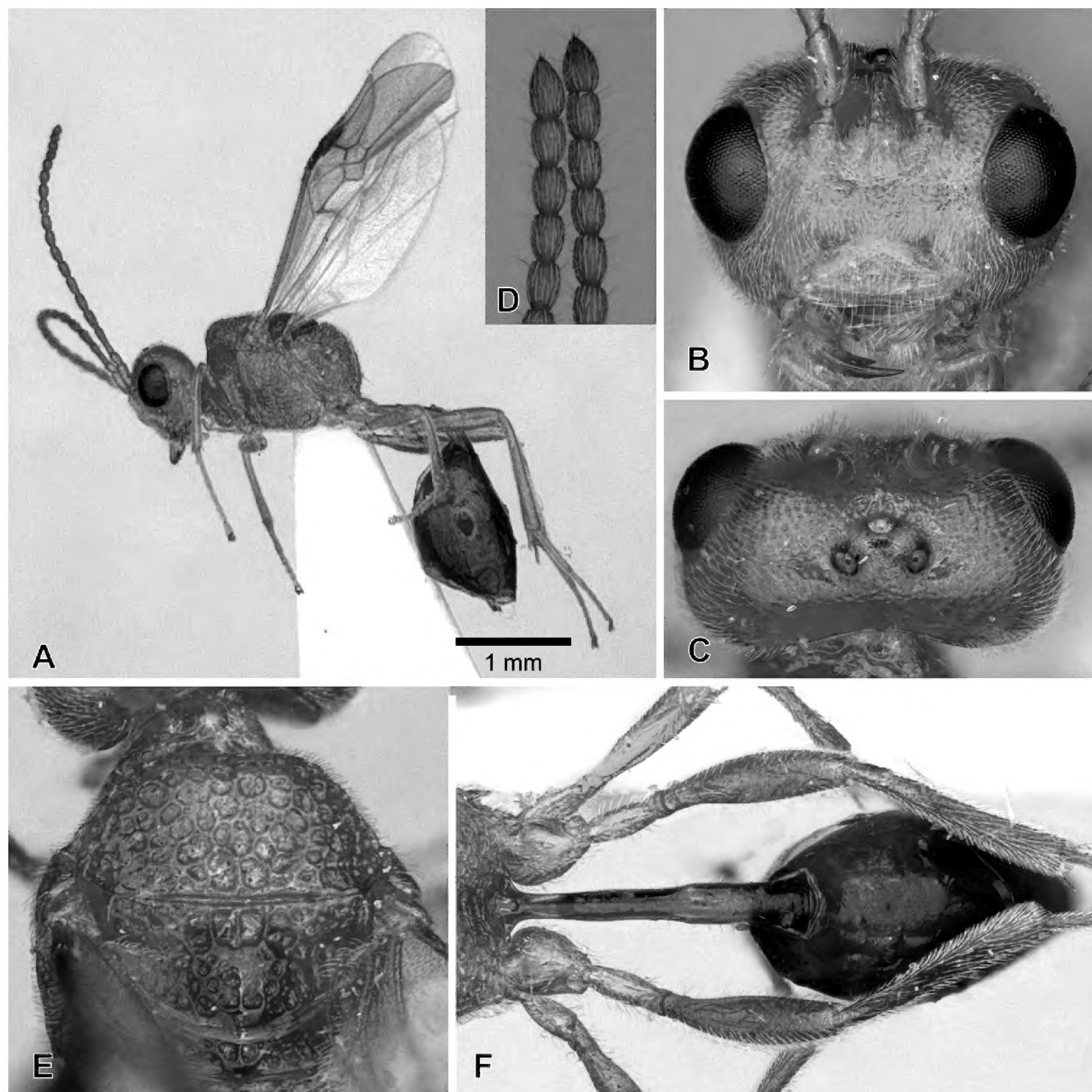
*Aridelus guizhouensis* Luo, 1985: 203. Syn. by Luo and Chen 1994. [Type locality: China]

**Material.** JAPAN **Honshû:** 1♀, Aomori Pref., Aomori City, Yokouchi-Yaegiku, 11.IX.1993, T. Ichita leg. (NARO); 1♂, Tōkyō Pref., Hachijō City, Minamiōsawa, Tōkyō Metropolitan University, 10.VIII.2010, N. Kikuchi leg. (OMNH); 1♀, Kyōto Pref., Yawata City, Yawatahayashinomoto, collected as a host larva of *Homoeocerus unipunctatus* feeding on *Pueraria lobata* on 12.VII.2021, cocoon formed on 23.VII.2021, and emerged on 29.VII.2021, S. Fujie leg. (OMNH); 2♀♀, Nara Pref., Yamatokōriyama City, Yamadachō, Nara-gakuen, 8.VII.2017, R. Itō leg. (OMNH); 1♀, Nara Pref., Yamatokōriyama City, Yamadachō, 6.IX.2016, R. Itō leg. (OMNH); 3♀♀, Nara Pref., Yamatokōriyama City, Yamadachō, Yata-kyūryō, about 135 m alt., 8.IX.2018, R. Itō leg. (OMNH); 1♀, same data except 13.IX.2018 (OMNH); 1♀, Nara Pref., Uda City, Haibarahagihara, Torimiyama-kōen, about 585 m alt., 20.VIII.2018, R. Itō leg. (OMNH); 1♀, Ōsaka Pref., Takatsuki City, Settsukyō, 24.IX.2017, S. Fujie leg. (OMNH); 6♀♀ and 1♂, Ōsaka Pref., Habikino City, Shakudo, 3.VIII.2020, S. Fujie leg. (OMNH); 2♂♂, same data except 22.VIII.2020 (OMNH); 2♀♀, same data except 2.VIII.2021 (OMNH); 1♀, Hyōgo Pref., Kawanishi City, collected as a host adult of *Riptortus clavatus* feeding on *Phaseolus vulgaris* on 24.VIII.2011, cocoon formed on 13.IX.2011, and emerged on 27.IX.2011, I. Hikino leg. (NARO); 1♂, same locality, host, collector and date of cocoon formation, collected on 29.VIII.2011 and emerged on 27.IX.2011 (NARO); 1♂, same locality, host, collector and date of cocoon formation, collected on 31.VIII.2011 and emerged on 28.IX.2011 (NARO); 1♀, Hyōgo Pref., Kōbe City, Nada Ward, Nadamaruyama Park, 23.VI.2019, M. & S. Fujie leg. (OMNH); 1♀, Hyōgo Pref., Asago City, Tataragi, 185 m alt., 30.VII. 2016, T. Tokuhira leg. (KPMNH); 1♀, Tottori Pref., Inaba Prov., Ketaka, Tsuyutani, alt. 20 m, 8.VIII.1964, H. Aoki leg. (OMNH); 1♀, Hiroshima Pref., Tōjō Town, Taishaku, 9.VIII.1978, K. Maetō leg. (NARO). **Kyūshū:** 1♀, Fukuoka Pref., Mt. Tachibana, 22.IX.1979, K. Maetō leg. (NARO); 1♀, Ōita Pref., Mt. Sobo, 800–900 m alt., 22.VII.1978, K. Maetō leg. (NARO); 1♀, Ōita Pref., Yufuin Town, Shimoyunohira, 1.IX.1991, M. Hiratate leg. (NARO).

**Distribution.** Japan (Honshū: Aomori, Tōkyō, Nara, Ōsaka, Hyōgo, Tottori and Hiroshima Prefectures; Kyūshū: Fukuoka and Ōita Prefecture) (Konishi and Maeto 2000; present study); China, Russian Far East, Taiwan (Yu et al. 2016).

**Hosts.** *Homoeocerus unipunctatus* (Thunberg, 1783) (Alydidae) feeding on *Pueraria lobata* (Fabaceae) and *Riptortus pedestris* (Linnaeus, 1758) (Alydidae) on *Phaseolus vulgaris* (Fabaceae) (both new records). The family Alydidae is the first record of the host of the genus *Aridelus*.

**Remarks.** The female specimens examined agree well with the redescription by Chou (1987) and that in the key by Chen and van Achterberg (1997); they differ



**Figure 4.** *Aridelus flavicans* Chao, 1974, ♀ from Tōkyō Prefecture (except for **D** from Ōsaka Prefecture), Japan **A** habitus **B** head, frontal view **C** head, dorsal view **D** apical part of antennae **E** mesoscutum and scutellum, dorsal view **F** metasoma, dorsal view.

slightly by having the body length 4.1–5.3 mm (4.2–5.1 mm in the previous redescrptions) and the penultimate antennal segment 1.1–1.6× longer than wide (1.2–1.6× in the redescrptions).

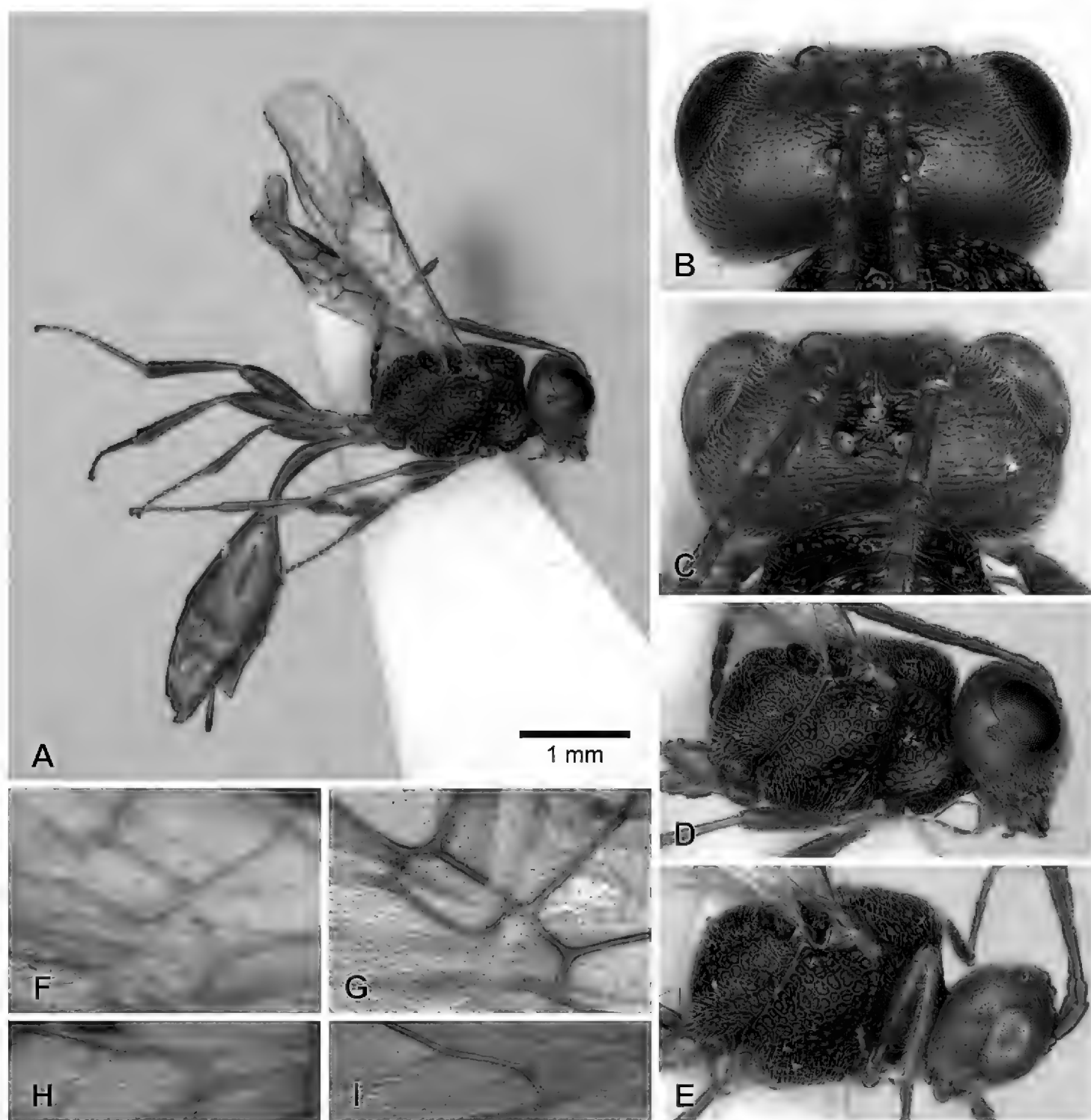
### *Aridelus rufotestaceus* Tobias, 1986

Fig. 5A–I

*Aridelus rufotestaceus* Tobias, 1986: 229 (English translation: 399); Chen and van Achterberg 1997: 18; Shaw et al. 2001: 132. [Type locality: Russia]

*Aridelus rufiventris* Luo & Chen, 1994: 483; Chen and van Achterberg 1997:18. Syn. nov. [Type locality: China]

**Material.** RUSSIA 1♀, *holotype*, Lazarevskoe, Sochi, forest along rivulet, 14.IX.1981, V. Tobias leg. (ZISP). JAPAN **Honshû:** 1♂, Shizuoka Pref., Shizuoka City, Shimizu Ward, Muramatsu, collected as a host adult of *Glaucias subpunctatus* on 14.XII.2018, recognized a cocoon on 23.I.2019, and emerged on 8.II.2019, K. Itoyama & A. Tsunashima leg. (OMNH); 1♂, Toyama Pref., Toyama City, Arimine, Inonedani, 1120 m alt., 15–22.IX.2009, MsT., M. Watanabe et al. leg. (KPMNH); 1♀, Mie



**Figure 5.** *Aridelus rufotestaceus* Tobias, 1986, ♀ from Yakushima Is. (A, B, D, F, H) and ♂ from Toyama Prefecture (C, E, G, I) **A** habitus **B, C** head, dorsal view **D, E** head and mesosoma, lateral view **F, G** second submarginal cell and vein m-cu of fore wing **H, I** vein 1r-m and 2-SC+R of hind wing.

Pref., Taiki Town, Nishiki, 9–21.X.2007, MsT., M. Nakaseko leg. (MUNJ); 1♂, Kyôto Pref., Yawata City, Morigaito, left bank of Kidu River, 17.VI.2018, S. Fujie leg. (OMNH); 1♀, Nara Pref., Uda City, Haibarahagihara, Torimiyama-kôen, about 585 m alt., 20.VIII.2018, R. Itô leg. (OMNH). **Hachijôjima Is.:** 2♂♂, Eigo, 2.VI.1964, Y. Hirashima & M. Shiga leg. (NARO). **Kyûshû:** 1♂, Kumamoto Pref., Izumi Vil., Gokanosô, 1.VIII.1981, H. Kurokawa leg. (OMNH). **Yakushima Is.:** 1♀, Kankake, 25.VIII–28.IX.2007, MsT., T. Yamauchi leg. (KPMNH); Mt. Aiko, 8–28.VI.2007, MsT., T. Yamauchi leg. (KPMNH); 1♀, same data except 29.VII–25.VIII.2007. (KPMNH); 1♀, same data except 28.IX–2.XI.2007. (KPMNH). **KOREA** 1♂, Kyongsangpuk-do, Mt. Sudo, 700 m alt., 9–12.VII.1971, K. Yamagishi leg. (MUNJ).

**Distribution.** Japan (Honshû: Shizuoka, Toyama, Mie and Kyôto Prefecture; Hachijôjima Is.; Kyûshû: Kumamoto Prefecture; Yakushima Is.); China, Georgia, Korea, Italy, Russian Far East (Yu et al. 2016; Lee et al. 2017). New to Japan.

**Hosts.** *Glaucias subpunctatus* (Walker, 1867) (a new record) and *Nezara viridula* (Linnaeus, 1758) (Shaw et al. 2001) (both Pentatomidae).

**Remarks.** Chen and van Achterberg (1997) indicated the differences between *A. rufiventris* Luo & Chen and *A. rufotestaceus* Tobias from only one specimen of each taxon in the sculpture of the vertex, the condition of vein m-cu of the fore wing, the relative length of vein 1r-m of the hind wing, and the colour of the mesosoma, as shown in Suppl. material 1: Table S1. However, these characters could not separate the Japanese specimens into the two species (Suppl. material 1: Table S1). These are most likely intraspecific variations. Hence, *A. rufiventris* is considered a junior synonym of *A. rufotestaceus*.

### *Aridelus rutilipoides* sp. nov.

<http://zoobank.org/7A58CF41-B558-41CA-A5E6-DBDF8D66D1F2>

Fig. 7A–I

**Type material.** *Holotype*, ♀, “(JAPAN) Nagano Pref., Ueda City, Sugadaira-kougen, Tsukuba Univ., 36–31N/138–20E, about 1300 m alt., 13 IX 2013 (sweeping), Sou Shimizu leg.” (OMNH). *Paratypes:* 1♀, Hokkaidô Pref., Sapporo City, Teine Ward, Mt. Teine, 18.IX.2013, S. Fujie leg. (OMNH); 1♀, Tochigi Pref., Nikkô, 13.X.1986, M. Miyazaki leg. (NARO); 1♀, Nagano Pref., Shimashima-dani, 1300–1600 m alt., 26.VIII.1978, K. Maetô leg. (NARO); 1♀, Tokushima Pref., Ichiu Vil., Mt. Tsurugi, 15.X.1980, Y. Shôno leg. (NARO).

**Etymology.** Named after its similarity to *A. rutilipes* Papp. The Latin suffix –“oides” taken from Greek means similar but not the same.

**Description.** *Female holotype* (Fig. 7). Body length 6.5 mm.

**Head** (Fig. 7B, C, D, E). Width of head 2.0× median length and 1.1× width of mesonotum. Length of eye 1.2× length of temple in dorsal view. OOL / OD = 4.1. POL / OD = 1.7. Vertex and temple densely punctate. Occipital carina complete.



Frons smooth and shining, with a distinct median carina. Face  $1.9\times$  as wide as high; finely punctate laterally, transversely punctate-rugose medially. Intertentorial distance / tentorio-ocular distance = 1.7. Clypeus finely punctate, slightly concave medially, without apical teeth. Length of malar space  $0.60\times$  eye height. Malar suture indistinct. Antenna filiform with 18 segments; 3<sup>rd</sup> segment  $3.5\times$  longer than wide and  $1.2\times$  longer than 4<sup>th</sup> one; penultimate one  $1.3\times$  longer than wide.

**Mesosoma** (Fig. 7F). Mesosoma areolate,  $1.3\times$  as long as high. Scutellum without median smooth area.

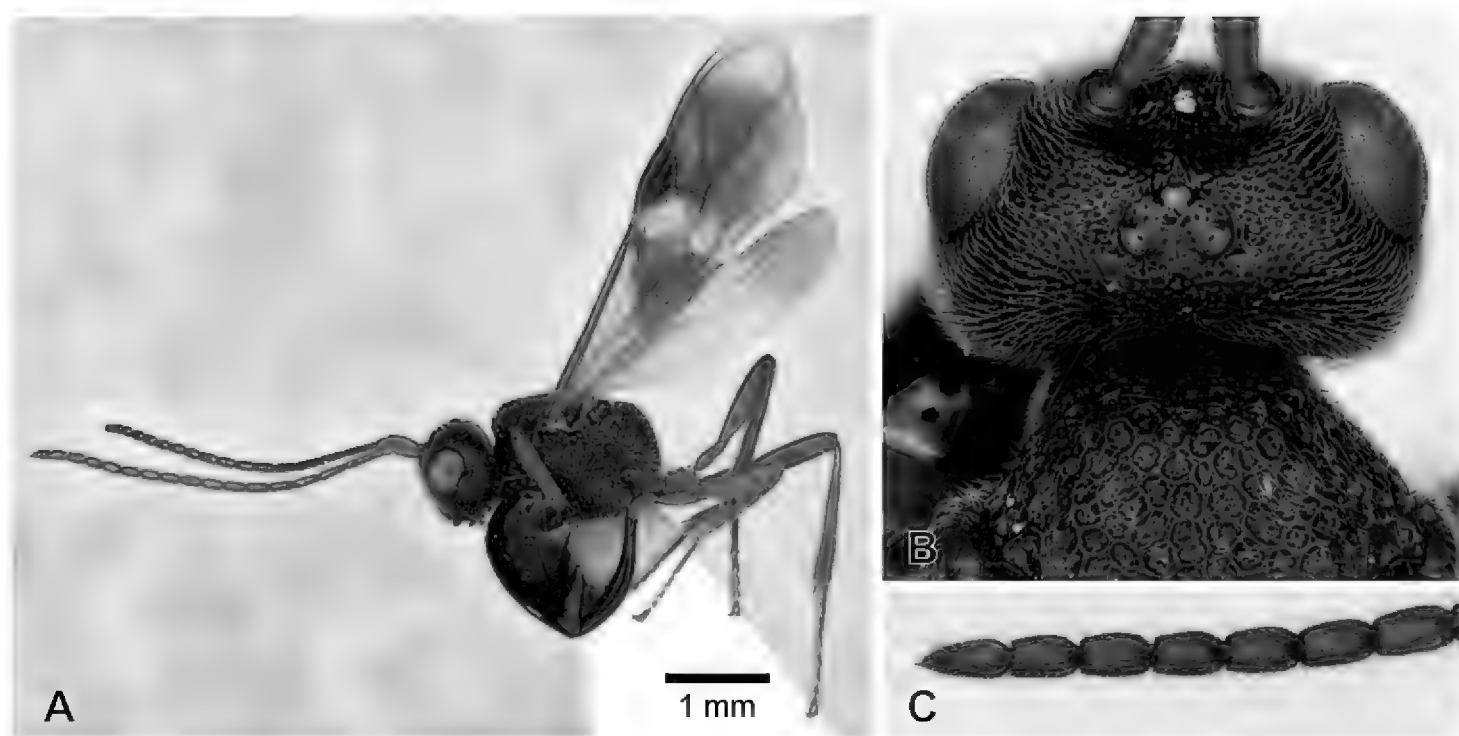
**Wings** (Fig. 7G). Fore wing 5.0 mm in length,  $1-R1$  / length of pterostigma = 1.3,  $r$  /  $3-SR$  = 2.4,  $m-cu$  distinctly antefurcal. Hind wing with  $1r-m$  /  $2-SC+R$  = 0.8.

**Legs** (Fig. 7H). Hind leg: femur  $5.2\times$  longer than wide, length of femur: tibia: basitarsus = 1: 1.3: 0.6.

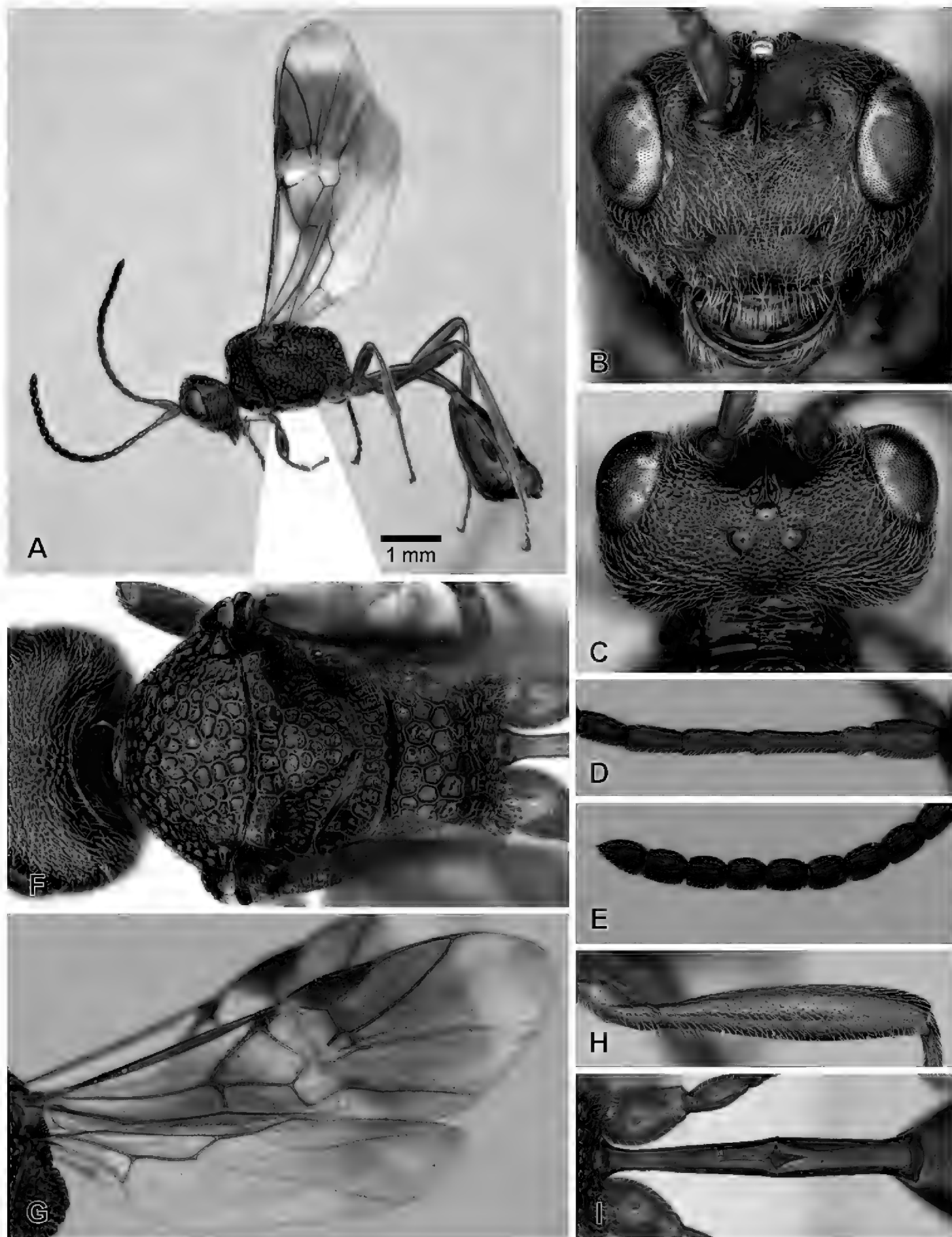
**Metasoma** (Fig. 7I). Metasoma smooth and polished. First metasomal tergite  $5.9\times$  longer than its apical width. Hypopygium truncated and excised apically. Ovipositor sheath hardly exerted beyond apex of metasoma.

**Colour.** Black. Antenna basally, mandible medially, palpi, tegula, legs except for telotarsus, metasoma reddish brown; mandible basally and apically, veins, telotarsus dark brown, antenna gradually darkened towards apex; pterostigma pale in basal quarter. Fore wing hyaline with two fuscous band. Hind wing with a fuscous band in apical third.

**Variation in females.** Body length 5.8–6.5 mm. Length of eye  $1.2$ – $1.4\times$  length of temple in dorsal view;  $OOL$  /  $OD$  =  $3.5$ – $4.1$ .  $POL$  /  $OD$  =  $1.5$ – $1.9$ . Face  $1.7$ – $1.9\times$  as wide as high. Intertentorial distance / tentorio-ocular distance =  $1.7$ – $1.9$ . Length of malar space  $0.5$ – $0.6\times$  eye height. Malar suture indistinct or absent. Third antennal segment  $3.5$ – $4.0\times$  longer than wide and  $1.2$ – $1.4\times$  longer than 4<sup>th</sup> one; penultimate one  $1.2$ – $1.3\times$  longer than wide. Mesosoma length  $1.3$ – $1.4\times$  height. Fore wing 4.8–5.2 mm



**Figure 6.** *Aridelus rutilipes* Papp, 1965, ♀ from Taiwan **A** habitus **B** head, dorsal view **C** apical antennal segments.



**Figure 7.** *Aridelus rutilipoides* sp. nov., ♀ holotype **A** habitus **B** head, frontal view **C** head, dorsal view **D** basal antennal segments **E** apical antennal segments **F** mesosoma, dorsal view **G** wings **H** hind femur **I** first metasomal tergite, dorsal view.

in length,  $1-R1 / \text{length of pterostigma} = 1.2-1.5$ ,  $r / 3-SR = 2.2-3.6$ . Hind wing with  $1r-m / 2-SC+R = 0.8-1.0$ . Hind leg: femur  $4.6-5.2\times$  longer than wide, length of femur: tibia: basitarsus =  $1: 1.3-1.4: 0.6$ . First metasomal tergite  $5.9-6.3\times$  longer than its apical width.

**Male.** Unknown.

**Distribution.** Japan (Hokkaidô; Honshû: Nagano Prefecture; Shikoku: Tokushima Prefecture).

**Hosts.** Unknown.

**Remarks.** This species closely resembles *A. rutilipes* Papp (Fig. 6) but differs in having the stouter penultimate antennal segment (in *rutilipoides*, 1.2–1.3× longer than wide (Fig. 7E), in *rutilipes* 1.8× (Fig. 6C)), the face finely punctate laterally, transversely punctate-rugose medially (finely punctate in *rutilipes*), the apical hyaline area of the fore wing not reaching the apico-posterior edge (Fig. 7G) (in *rutilipes*, reaching the apico-posterior edge (Fig. 6A)) and the metasoma reddish brown (Fig. 7A) (dark brown in *rutilipes* (Fig. 6A)). This species also resembles *A. dubius* Belokobylskij, but differs in having the antenna gradually darkened towards the apex (Fig. 7A) (in *dubius* uniformly reddish brown, not darkened towards the apex (Fig. 1A)), the penultimate antennal segment stouter (in *rutilipoides*, 1.2–1.3× longer than wide (Fig. 7E), in *dubius* 1.6–1.7× (Fig. 1E)), the face finely punctate laterally, transversely punctate-rugose medially (finely punctate in *dubius*), the malar suture indistinct or absent (distinct in *dubius*) the apical hyaline area of the fore wing comparatively large, almost reaching the apex of the marginal cell (Fig. 7G) (in *dubius* comparatively small, not reaching the apex of the marginal cell (Fig. 1F)), the vein m-cu of the fore wing antefurcal (Fig. 7G) (slightly postfurcal to interstitial in *dubius* (Fig. 1F)), and the hind femur slenderer, 4.6–5.2 times as long as wide (Fig. 7H) (4.1–4.3 times as long as wide in *dubius* (Fig. 1G)). This species is also similar to *A. ussuriensis* Belokobylskij, 1981 described from the Russian Far East, but differs in having the vertex densely punctate (vertex with distinct transverse striation in *ussuriensis*), the mesosoma black (mesosoma red except for the prothorax black in *ussuriensis*) and the metasoma entirely yellowish brown (metasoma black except for the red first metasomal tergite in *ussuriensis*).

## Discussion

Among the six Japanese species, *A. egregius* and *A. rufotestaceus* are widely distributed in the Palaearctic region, but four other species (*A. dubius*, *A. elasmuchae*, *A. flavicans*, and *A. rutilipoides* sp. nov.) are virtually confined to East Asia (China, Japan, Korea, the Russian Far East and Taiwan). Two Japanese species, *A. rutilipoides* sp. nov. and *A. dubius*, have a comparatively larger body and the fore wing with two fuscous bands and belong to a species complex with *A. rutilipes* from continental China, Korea, and Taiwan, and *A. ussuriensis* from continental China, Korea, and the Russian Far East. A comprehensive study on the fauna and phylogeny of *Aridelus* in and around East Asia is required.

All previously known host families of *Aridelus* (Acanthosomatidae, Pentatomidae, Plataspidae, Scutelleridae) belong to the superfamily Pentatomoidea (Shaw et al. 2001), but our study has revealed that *Aridelus* can also use the superfamily Coreoidea (including Alydidae) as host insects. While the most widely distributed species,

*A. egregius*, is known to parasitize three host families, other Japanese species so far only one host family is known (Yu et al. 2016; present study). The host specificity of *Aridelus* species is an interesting problem that deserves further study.

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## Supplementary material I

### Table S1

Authors: Shunpei Fujie, Kaoru Maeto

Data type: xlsx file

Explanation note: Comparison of Chinese specimens of *Aridelus rufotestaceus* Tobias and *A. rufiventris* Luo & Chen with Japanese and Korean specimens of *A. rufotestaceus*.

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